

**CEN/ISSS Workshop ELSSI–EMD**  
**Economics and logistics of standards-compliant**  
**schemas and ontologies for interoperability**  
**of engineering materials data.**

**Business Plan**  
**Final adopted**

**Source: CEN and proposers**

**Status: approved at the Workshop**  
**kick-off meeting on 12 May 2009**

## 1. Title

Title: Workshop on “Economics and logistics of standards-compliant schemas and ontologies<sup>1</sup> for interoperability of engineering materials data”.

## 2. Background to the CEN Workshop

This CEN/ISSS Workshop is concerned with the viability of using standardised schemas and ontologies to represent data derived from procedural materials testing standards.

Science and engineering data, if conserved at all, are available in a set of heterogeneous and distributed repositories. The data sets themselves come in a variety of formats and with very different semantics associated with them. Users also have a variety of working environments and software tools. All these systems are in a constant state of change. This project aims to investigate the viability of using standards-compliant schemas and ontologies in the context of broader community actions intended to address systems interoperability and to promote the capture and conservation of experimental data in the materials sector.

It is approximately ten years since work first began at NIST<sup>2</sup> to develop the MatML schema<sup>3</sup> for materials properties, and even with recent efforts at a transition to a corresponding ontology, systems interoperability, and capture and curation of materials data remain largely unaddressed. Data sets associated with individual publications, large international projects such as ITER, and emerging technologies such as nanomaterials remain largely inaccessible and inadequately curated. This failing appears not to be confined to the materials sector, it is pervasive. This is evidenced by a recent inventory study commissioned by the DRIVER project, which indicates that less than 10% of the content of OAI repositories is primary data.

Due consideration will be given to standards for relevant technologies; including inter alia MatML, the tensile testing work of ISO TC164/SC1 and TC184/SC4.

The scope of the Workshop is confined to the engineering materials sector and a single materials testing standard as an example to test the validity of the approach. The Workshop should thus be considered a path-finding exercise designed to establish whether what is proposed can contribute to a solution to interoperability of materials facilities and curation of materials data. If shown to be viable, it is then that the real work will begin, meaning that the procedure could be extended to a large number of testing standards in the engineering sector.

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<sup>1</sup> Source Wikipedia: In computer science, an **ontology** is a formal representation of a set of concepts within a domain and the relationships between those concepts. It is used to reason about the properties of that domain, and may be used to define the domain.

<sup>2</sup> NIST National Institute of Standards and Technology, USA.

<sup>3</sup> MatML is an OASIS open draft specification.

An effective solution to systems interoperability and data curation will require various complementary actions, of which this Workshop will hopefully be one. To capture and curate materials data more effectively, and to improve interoperability of materials facilities, will require a collective effort on the part of the materials community, not only to improve data definition languages and ontologies, but also to engage all stakeholders. This is exactly the approach proposed for this Workshop, which aims to engage the business, academic, and standardization communities in a 12 months exercise to investigate the business case for implementing standards-compliant schemas and ontologies, and the implications for the standardization organizations. A CEN/ISSS Workshop provides the perfect environment to undertake an effort that involves the research, business, and standardization communities.

### 3. Outline of Proposed Work

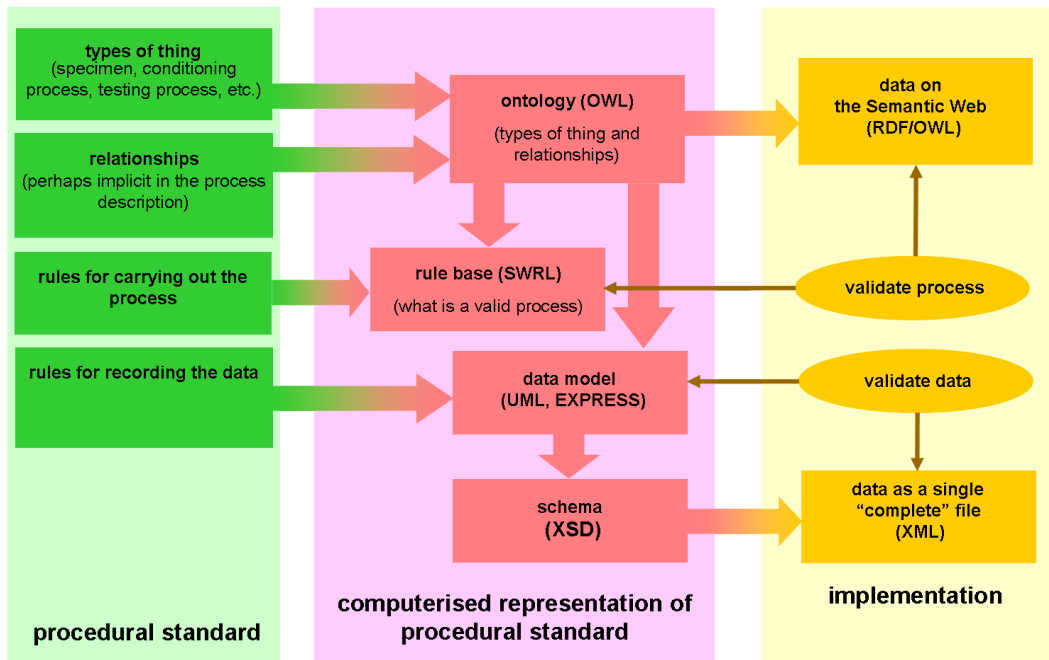
The work that will be performed on behalf of the Workshop participants thus consists of studies that will take into consideration the interests of each of the research, business, and standardization communities:

**Research**—the engineering sciences produce a significant volume of experimental data of an high inherent value. Standards-compliant schemas and ontologies offer a possible solution to data capture, the long-term preservation of the data, and interoperability of heterogeneous facilities. The Workshop will investigate the opportunities for the more effective curation of data by delivering schemas, ontologies and rulesets for a chosen test standard as a demonstration.

An effort to implement standardised schemas and ontologies for a single procedural testing standard will provide insights into the issues encountered during the process and whether schemas have a role to play in the development of ontologies. The work will also establish whether schemas and ontologies have their own individual merits in a solution to interoperability and data capture, and how standards-compliant schemas and ontologies can be leveraged in the context of related efforts in other disciplines.

The Workshop shall take due account of existing relevant activities. ISO 10303-235, and MatML make major contributions to the solution of the problem that no common formats exist to catalogue materials test data and the schema can be implemented in software to provide direct input into engineering systems.

Schema implementation is also expected to establish viable hierarchies and structures that will complement the development of ontologies and rulesets. The following figure depicts the relationships between procedural standards, schemas, ontologies and rulesets:



**Figure 1.** Relation between procedural standards and schemas, ontologies and rulesets.

The development of the ontologies and rulesets is consistent with present research trends, and their development should be consistent with and complementary to related initiatives, such as the W3C Product Modelling Incubator Group<sup>4</sup>, and the CODATA Materials Data Task Group of the World Materials Research Institutes Forum (WMRIF)<sup>5</sup>.

The development of standards-compliant ontologies also ensures the European Standards Organizations are engaged in the activity, which is important because the efficacy of the ontologies may depend on their adopting the role of URI (Uniform Resource Identifier) hosts.

**Business**—various commercial sectors, including financial services, media, and telecoms, have experienced paradigm shifts in business practice in response to the internet and its associated technologies. The introduction of standards-compliant formats for exchanging data could have similar implications for the engineering sector in areas such as SaaS (Software as a Service), SoS (Systems of Systems), testing, and publishing. Such formats could also be expected improve auditing and traceability of property data for design. The Workshop will thus investigate the business cases for standards-compliant schemas and ontologies.

An evaluation of the business case for standards-compliant schemas and ontologies will begin with a critical review of the current state of data related business activities in the materials engineering sector. By comparison with the biological sciences, the pharmaceutical sector, it is not unreasonable to hypothesize that the poor state of systems interoperability and curation in materials sciences has been adversely affected by the lack of specific schemas for this business sector. Further, in the case of materials data, it may simply be the case that without

<sup>4</sup> <http://www.w3c.org>

<sup>5</sup> [http://www.e-materials.net/network/WMRIF/modules/about\\_forum/](http://www.e-materials.net/network/WMRIF/modules/about_forum/)

schemas for test data the materials schema is simply of limited use. These and other avenues should be investigated.

The review will then proceed to evaluate whether standards-compliant schemas and ontologies offer an opportunity to improve existing business activities and offer opportunities for new business, such as SaaS, system integration and a supply chain and market for materials test data. This will be attempted by undertaking a broad examination of commercial activities in the business sector, in combination with case studies in specific business areas, which could include digital certification, publishing, mechanical testing, and component manufacture.

**Standardization**—if schemas and ontologies can be shown to be developed in accordance with corresponding procedural standards, the implication is that those schemas and ontologies should be maintained by the custodians of the procedural standards.

A review of the implications for standards organizations will be undertaken that examines the benefits and disadvantages of this added responsibility. The additional overhead that will inevitably accompany these new responsibilities should be balanced against possible increased revenue arising from new business opportunities, and it is expected that this aspect will be investigated.

The review is expected to extend beyond simply investigating the practicalities of maintaining the schemas and ontologies, and also assess the possibility of the standards organizations adopting the role of URI hosts and custodians of ontologies.

#### 4. Expected outcomes and benefits

A successful outcome to the project will establish a common understanding amongst all stakeholders of the systems interoperability and data curation issues facing the materials community, and mobilize the same stakeholders to undertake complementary actions to deliver effective solutions, including the implementation of standards-compliant schemas and the development of ontologies.

If shown to be viable, standard-compliant schemas, ontologies and rulesets have the potential to offer many possible advantages to European business and research, including:

- **Interoperability of heterogeneous facilities**—by delivering common data formats, standards-compliant schemas and ontologies offer a solution to systems interoperability.
- **Improved business practices**—standards-compliant schemas and ontologies have the potential to improve data related business practices, such as the introduction of digital test certificates, enhanced authoring processes, data pipelining direct from test facility, uniform data input to databases, design tools, etc.
- **Improved research process**—by promoting the capture and preservation experimental data, standards-compliant schemas and ontologies will enable validation of new models, knowledge discovery, etc and will contribute to improved auditing and transparency.
- **Preservation of financial investment**—materials test programmes are expensive, especially so for major undertakings (such as ITER) and emerging technologies (such as

nanomaterials). Standards-compliant schemas will promote data capture and curation, and hence preserve the financial investment.

- **Preservation of electronic data**—for data to be long-lived, the format of that data needs to be long-lived. Appending the schemas, ontologies and rulesets to their corresponding procedural standards will promote their longevity and that of the data. Similarly, registration of the standards-compliant schemas, ontologies, and formatted data at a suitable repository (such as the DCC RRoRI<sup>6</sup>) will complement ongoing efforts by the digital curation community to promote long-term preservation of electronic records.
- **Added value**—ontologies and rulesets add value to data, thereby promoting the longevity of the data by increasing its usefulness.
- **Systems standardization**—new systems will inevitably conform to standards-compliant schemas. This will promote the development of a tightly integrated, robust infrastructure capable of supporting high volume transactions and a vibrant commercial environment.
- **Standards consolidation**—the development of standards-compliant schemas and ontologies will consolidate ICT standardization efforts by contributing to existing standards rather than introducing new standards. Proliferation of ICT standards is not consistent with a meaningful standardization effort—maintenance and duplication of data models are issues.
- **Quality assurance**—a schema defines the key features of a particular activity in a specific domain, whether it be compliance with health and safety regulations, adherence to quality measures, or mechanical testing procedures. Knowing the extent of these parameters and the extent of data means that a quantitative measure of data quality can be derived.
- **Sector acceptance**—an issue with technologies for digital curation and interoperability is that the technology is introduced without consulting all stakeholders.
- **Sector-agnostic**—although the focus of ELSSI-EMD is materials test data, the guidelines to convert procedural standards to schemas, ontologies, and rulesets will be broadly applicable to different sectors.

If the development of standards-compliant schemas is proven to be feasible, economic impacts are not limited to new business. Improved interoperability and curation will mean data are available in a format that is more amenable to transfer and long-term storage.

For industry, practical benefits include less time spent by organisations checking material test certificates manually and a lower likelihood of having to regenerate results due to lost data.

For materials suppliers and the manufacturers of materials testing equipment the availability of the standard formats that the schemas will deliver will remove all obstacles to the delivery and exchange of data, and will guarantee interoperability heterogeneous systems.

Research organizations will gain a competitive edge when competing for grants. Research councils and funding bodies are becoming increasingly aware of the value of sharing and reusing data, and some funding agencies will no longer dispense funds to scientists who have not planned for how their data will be collected and conserved. This trend is likely to become more prevalent, and any research organization that can demonstrate an active interest in curation activities in their particular domain will gain a competitive edge when competing for grants.

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<sup>6</sup> Registry/Repository of RI (RRoRI) developed initially in DDC (Digital Curation Centre).

As procedural standards already define the benchmarks for mechanical testing, standards-compliant data formats will inevitably find industry-wide adoption. To promote their adoption, efforts will be undertaken to inform the relevant industrial consortia (component manufacturers in the power, aerospace, and automobile sectors for example). Efforts will also be undertaken to promote the output at CODATA and the Global Database working group of the 'World Materials Research Institutes Forum' (WMRIF).

## 5. Workshop proposers and Workshop participants

The CEN/ISSS Workshop is proposed by the following organizations: Soasys Ltd, Caesar Systems Ltd, the Digital Curation Centre, Alstom Power Ltd, Imperial College and Elsevier BV. These organizations have already indicated their commitment to participate in the Workshop.

Participation at the Workshop is open to any organization/body with an interest in the subject. There is no fee for participating but each participant will bear their own expenses for attending meeting.

Stakeholders in the following sectors and domains will be invited to join the CEN/ISSS Workshop:

- **Industry**—including materials manufacturers, aerospace, automobile, and power generation component manufacturers, software and publishing houses.
- **Materials data providers**—including machine manufacturers, testing houses, industrial consortia, and publishing houses.
- **Standards development organizations**—including those that drive the development, convergence and adoption of e-business standards, and those bodies that develop mechanical testing standards.
- **Digital curation community**—including repository hosts and committees promoting data preservation.
- **Materials research organizations**—including universities and research institutes.

## 6. Workshop objectives

The CEN/ISSS Workshop ELSSI-EMD will investigate the viability of standards-compliant schemas and ontologies for systems interoperability and the long-term preservation of experimental data in the engineering materials sector.

The CEN/ISSS Workshop ELSSI-EMD will establish the business case for standards-compliant schemas and ontologies in the engineering materials sector and investigate the implications of standards-compliant schemas and ontologies for the procedural standards to which they correspond.

The result will be a CEN Workshop Agreement (CWA) with guidelines for the effective development and implementation of standards-compliant schemas, ontologies, and rulesets. The CWA will also contain a proposed programme of further actions, both inside and outside the standardization environment.

In particular, the CWA will include:

- **A Feasibility Study**—to implement and develop schemas, ontologies, and rulesets compliant with a single mechanical testing standard and guidelines on the relative merits and limitations of the chosen technologies.
- **Economic Forecast**—this action will deliver a critical review and a series of case studies to establish the business case for standards-compliant schemas and ontologies.
- **Standardization Practices**—this action will deliver a critical review of the implications of standards-compliant schemas and ontologies from the perspective of stakeholders with an interest in maintaining the corresponding procedural standards.

The following additional deliverables will be submitted:

- **Interim report** (October 2009) consisting of the draft CWA containing guidelines for developing standards-compliant schemas and ontologies, the findings of the business forecast, and an evaluation of the impact on the standards business model.
- **Final report** (May 2010) consisting of the final text of the CWA.

## **7. Workshop programme**

A new CEN/ISSS Workshop will be set up for a proposed duration of 12 months.

The Workshop working language is English. The CWA will be produced in English only.

The detailed work-programme is contained in the table below:

<b>Activity</b>	<b>Milestone</b>	<b>Who</b>	<b>When</b>
Launch Workshop and call for experts	WS kick-off meeting	CEN	Brussels, 12 May 2009
Experts selection and start analysis phase		Chair, Secretary, CEN PM	May/June 2009
Outline CWA		PT	August 2009
First draft CWA containing the feasibility study		PT	September 2009
Comments on first draft CWA		WS members	September 2009
Second draft CWA – to be submitted as interim report to EC	2 <sup>nd</sup> WS plenary meeting - Delft (NL), 8 Oct.	PT	October 2009
Third draft CWA - Implementation and IPRs options - Critical review of implications of standards compliant schemas and an evaluation of the impact on the standard business model	3 <sup>rd</sup> WS Plenary meeting	PT	December 2009
Public comment period		all	Jan-Feb 2010
Fourth (final draft CWA) including all comments received		PT	March 2010
CWA endorsement and WS closure	4 <sup>th</sup> WS plenary meeting (or electronic endorsement)	WS members	April/May 2010

## 8. CEN Workshop structure and resources

The Workshop managing structure is composed by a Chair, a Secretary and a small Project Team of experts.

The Workshop Chair main tasks are:

- To preside at Workshop plenary meetings;
- To ensure that the Workshop delivers in line with its Business Plan
- To manage the consensus building process
- To interface with CEN regarding strategic directions, problems arising, etc.

The Workshop Chair will work on a voluntary basis.

NEN, the Dutch standardization body, will carry out the Secretariat functions.

Details about the Project Team are contained in the document: Terms of Reference for the Project Team.

The Secretariat and the Project Team are supported by EU/EFTA funding. A total of 246 man/days are available, provided that the Workshop attracts sufficient participation.

## 9. Liaisons

The Workshop will liaise with:

- ISO TC 211 and CEN TC 287 geographical information
- ISO TC 184/SC4 and CEN TC 310 industrial automation systems and integration
- ISO TC 164 SC1 for testing
- OASIS TC on materials mark-up, if revived
- CEN Workshop eCAT - ePPS project: electronic Product Property Server
- CEN Workshop ORCHID (Orchestrating industrial data)
- ASD STAN (standards requested by the European aerospace industry)
- NATO CSM WG

The Workshop will also liaise with relevant research projects at European level.

## 10. Contact points

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